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INSTALLATION AND OPERATING INSTRUCTIONS

CONRAC®

AUDIO-VIDEO RECEIVER

MODEL AV12D

S/N 40609

INSTRUMENT SERVICES

CONRAC, INC. GLENDORA, CALIFORNIA

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CONRAC AV12D RECEIVER

The Conrac AV12D is a television Audio-Video Demodulator particularly designed for monitoring, video recording or re-broadcasting applications. It supplies composite video and separate audio from "off-the-air" signals. The unit employs a total of eighteen tubes, one crystal diode, and two silicon power rectifiers.

It is especially suitable for reception of NTSC COLOR signals. The AV12D is factory aligned with the picture carrier (45.75 mc) at minus 6 db. A video sweep or "Multiburst" test will show the over-all response to be flat to within 1 db from 60 cycles to 4.1 mc. Bifilar-T traps are employed to reduce phase distortion at band edges and to improve the transient response.

The Model OC Crystal Control Unit is available to control the frequency of the local oscillator on any one VHF channel. It is particularly useful in remote installations where the unit must be operated for several weeks or months without maintenance. It consists of a crystal oscillator and multiplier chain built on a small sub-chassis which will mount inside the AV12D receiver. An "on-off" switch is provided on the front panel to permit normal operation of the receiver (without benefit of crystal control) on the remaining channels.

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MODEL AV12D, FRONT VIEW

TECHNICAL SUMMARY

ELECTRICAL SPECIFICATIONS

Input Power	117/234 volts AC, 50/60 cycles, 95 watts, fused.
Input Signals	Normally supplied for balanced 300 ohms. If specified, the tuner may be reconnected at the factory for 75 ohm input, using an SO-239 (83-1R) connector.
Outputs	Video: 1.4 volts (adjustable) at 75 ohms, sync negative, SO-239 (83-1R) connector. Audio: Zero dbm, 600 ohms balanced. Peerless Output Transformer, flat 20 to 20,000 cycles with standard 75 microsecond de-emphasis. Screw terminals. For other impedances, see Page 9.
Controls	Channel Selector, Fine Tuning, Video Level, Audio Level, RF Gain, AGC Selector, Power Switch, AGC Delay and Detector Level.

TUBE COMPLEMENT

V1	6ER5	RF Amplifier
V2	6CG8	Converter-Oscillator
V101	6BZ6	First IF Amplifier
V102	6BZ6	Second IF Amplifier
V103	6BZ6	Third IF Amplifier
V104	6CB6	Fourth IF Amplifier
V105	6AN8	First Sound IF Amplifier
V106	6AU6	Second Sound IF Amplifier
V107	6AL5	Sound Detector
V108	OA2	Voltage Regulator
V109	12AU7	Push-Pull Audio Output
V110	6AQ5	First Video Amplifier
V111	12AT7	Second Video Amplifier
V112	5687	Third Video Amplifier
V113	6AL5	AGC Clamp and Bias Rectifier
V114	6AU6	AGC Keyer
V115	6AQ5	Keying Pulse Amplifier
V116	6BY6	Sync Separator

DIMENSIONS	Mounts in standard 19" relay rack, 7" high by 12-3/4" deep.
FINISH	Deep Umber Gray, Baked Enamel
SHIPPING WEIGHT	35 lbs.

UNPACKING AND INSTALLING

Carefully remove all packing material from the equipment received and inspect it for possible damage incurred during shipment. Report any shortage or damage to the carrier.

ANTENNA INPUT

The receiver is normally furnished for 300 ohm antenna input and equipped with screw terminals for 300 ohm lead-in wire. The unit may be provided for 75 ohm coaxial input and equipped with an SO239 (#83-1R) connector at the factory if so specified. If it is necessary to change a receiver from 300 ohm input to 75 ohm input in the field, the necessary brackets and instructions will be furnished from the factory at no charge.

RECEIVER INSTALLATION

When installing the receiver in a relay rack, better results will be obtained if care is taken to select a location where the temperature is relatively constant and not excessively hot.

PRELIMINARY ADJUSTMENTS

The receiver should be allowed to warm up completely before tuning. Normally the fine tuning will be adjusted while observing a picture monitor. However, it is practical to use a waveform monitoring oscilloscope, and adjust the fine tuning control to reproduce a null in the 4.5 mc "fuzz" on the scope trace.

AGC CONTROL SETTING

For normal operation, the AGC switch should be placed in the "AGC" position. The AGC switch provides for manual gain control operation if desired, in either the "D" (delayed) or "N" (normal) position.

CRYSTAL CONTROL

In units employing the auxiliary crystal control units, the following procedure is recommended:

1. Throw the "Crystal Control" switch (located on the front panel) to the "off" position.

2. Tune in the desired station with the fine tuning control in the normal manner. The optimum tuning point should be in the approximate center of the fine tuning control range. If this is not the case, refer to Local Oscillator Adjustment, page 7. If the local oscillator tunes correctly, mark the position of the fine tuning control.

3. Restore the "Crystal Control" switch to the "on" position.

4. Move the fine tuning control both ways from the marked position to determine whether loss of crystal control occurs, and the range of control. The crystal control should preferably hold the local oscillator

on frequency over most, if not all, of the fine tuning control range. Leave the fine tuning control in the marked position.

NOTE: The "Crystal Control" switch must be turned off if the receiver is operated on any channel other than the one for which the crystal was supplied.

LOCAL OSCILLATOR ADJUSTMENT

Turn the "Crystal Control" switch off. If the Fine Tuning control knob does not turn far enough to properly bring in a particular station, set the Fine Tuning control at the middle of its range. Remove the Fine Tuning and Station Selector knobs. The local oscillator adjustment screw can be adjusted through the hole located 1/2" to the left and 3/4" above the station selector shaft. As the station selector is turned to a different station, a new screw will appear in the hole. Use a non-metallic screwdriver. Turn the oscillator adjustment screw clockwise until the picture has sound interference in it; turn the screw counterclockwise until the interference just disappears. A fraction of a turn will be sufficient.

If the oscillator adjustment screw should fall into the coil form, remove the bottom tuner cover, and then remove the channel coil of the station concerned. Move the screw retaining clip out of its slot and tap the coil assembly until the screw slips forward. Set the retaining clip in place firmly against the screw and reassemble the tuner.

AGC DELAY CONTROL

Insert a 15 db pad into the R.F. input (antenna) circuit. The AGC delay control on the front panel should be turned clockwise as far as it will go, and then counter-clockwise to a point where the snow in the picture has just reached its minimum.

AGC BIAS ADJUSTMENT (DETECTOR LEVEL CONTROL)

The video level at the detector is controlled by the setting of the Detector Level Adjust control on the rear apron. It should be set so that with the video gain control at its maximum setting the voltage level in the video output line is perhaps 20% above the desired output level, normally 1.4 volts peak-to-peak. The broadcast sync pulse is a reasonably reliable indication of level. If the sync pulse amplitude (distance from black level to peak sync) is set to approximately 1/2 volt peak-to-peak, the output of the unit will be approximately 20% above its normal 1.4 volts. The video level may then be reduced to 1.4 volts with the Video Gain control on the front panel. Negative feedback and high AGC loop gain effectively stabilize the output of the AV12D. Setting the available output at a level higher than necessary merely compromises the receiver AGC with no corresponding benefit.

PERFORMANCE CHECK

As a check of alignment, it is recommended that the AV12D be tested with a video transmitter. If "air time" on the transmitter to be received is not available, a test unit, such as the Kay "Megapix", should be satisfactory. The video transmitter should be modulated by a "Multiburst generator. All the burst should be equal in peak-to-peak amplitude within 1 db, although it will be noted that the "leading edge" of the 4.1 mc burst will be rounded off, as shown in Fig. 8, page 21.

CIRCUIT DESCRIPTION

STATION SELECTOR

The receiver employs a 12-position neutrode turret tuner, Standard Coil type GG. The standard input impedance is 300 ohms balanced. If specified, the unit can be supplied for 75 ohm coaxial cable input, using an SO-239 (83-1R) connector. Spurious oscillator radiation falls well below FCC limits. The four stage IF amplifier has a converter grid sensitivity of 75 db. Response curves are reproduced on pages 20 and 21.

IF AMPLIFIER

The converter to first IF grid coupling network consists of a "staggered couple" with a bifilar-T trap. The mixer plate circuit ("primary") is tuned to approximately 42 mc and loosely coupled to a bifilar-T circuit, T101, which is tuned to approximately 45 mc. The associated trap is set to reject 41.25 mc.

The next three interstage networks comprise a "flat staggered tuned triple" with adjacent channel traps. The first network is a shunt fed bifilar-T circuit. It, T103, is broadly tuned near 43 mc and the trap is set to produce about 30 db of attenuation at 47.25 mc.

The second IF coupling network, T104, is a standard bifilar wound coil tuned to approximately 42 mc. A coupled trap tuned to 39.75 mc rejects upper adjacent channel picture information. T105 is quite similar to T104 and is tuned to approximately 45 mc with a coupled trap tuned to 47.25 mc for rejection of lower channel sound interference.

The coupling network between the fourth IF amplifier, V104/6CB6, and the video detector provides over 30 db of attenuation for the 41.25 mc accompanying sound component and has an essentially flat response from 41.75 mc to 45 mc. The input section of the filter is tuned to 45 mc and the output section is tuned near 42 mc. The sections are coupled by a bridged T network which rejects 41.25 mc. A crystal detector is used rather than a thermionic diode to provide optimum linearity and reduce capacitive loading.

VIDEO AMPLIFIER

A series connected trap is located in the video detector output circuit, tuned to 4.5 mc to reject any spurious beats between sound and picture carriers.

The first video amplifier, V110/6AQ5, is connected as a cathode follower to drive the video gain control and also as a conventional video amplifier to drive the keyed AGC system.

The second video amplifier consists of the two sections of a type 12AT7 tube connected as a "feedback pair". This amplifier has a maximum gain of about four times, and is flat to approximately 10 mc. The out put stage employs a 5687 tube in a circuit which combines the advantages of a cathode follower with a plate loaded amplifier to minimize differential gain and phase distortion.

KEYED AGC SYSTEM

Video information from the plate of the first video amplifier stage, V110/6AQ5, is fed to a sync stripper, V116/6BY6. Stripped sync is amplified in V115/6AQ5 and fed through a pulse transformer, T113, to the AGC keyer tube, V114/6AU6. Waveforms are shown on page 21.

Video level information from the plate of V110 is supplied to the control grid of the AGC keyer tube, V114. A negative voltage which is proportional to the peak carrier level is developed in the plate of V114. An adjustable fraction of this voltage is supplied to the grid return of the first three IF amplifiers. A portion is also supplied to the first RF amplifier grid through a suitable delay and clamping network. The AGC voltage will maintain the peak video voltage at the detector at a constant level over an extremely wide range of input signal strengths.

AUDIO CIRCUIT

The sound is removed at the plate of the last video IF amplifier, V104/6CB6. At this point, the level of the sound carrier component is about 26 db below the picture component of the signal, which is the optimum ratio for intercarrier sound detection. The sound signal is converted to 4.5 mc with a diode, V105/$\frac{1}{2}$6AN8, and fed through a two-stage 4.5 mc amplifier to a ratio detector. The second stage of the 4.5 mc amplifier functions as a limiter, which in conjunction with the ratio detector, gives excellent rejection of amplitude modulation.

A cathode coupled push-pull audio output stage is used to drive a high quality output transformer.

The audio output transformer is normally connected to feed a 600 ohm balanced audio line. It may be reconnected to provide various output impedances, as shown by the table below:

IMPEDANCE	OUTPUT TERMINALS	STRAP
500/600	7-12	9-10
333/400	8-12	9-10
250/300	7-12	9-11
200/240	8-11	9-10
125/150	7-9	7-10 & 9-12
50/60	8-11	8-10 & 9-11

OC SERIES CRYSTAL CONTROL CIRCUIT (Optional Equipment)

The oscillator of this unit employs a fifth overtone crystal, type CR 23/U, and generates frequencies in the band from 50 mc to 65 mc. This is followed by a frequency doubler stage in Models OC-2 through OC-6, and by two frequency doubler stages in Models OC-7 through OC-13. The output is link-coupled to the local oscillator in the turret tuner at the proper amplitude to tightly lock the local oscillator to the correct frequency, as determined by the crystal.

A vernier frequency adjustment is accessible through a hole in the front panel. A switch is provided on the front panel to turn off the crystal unit. When this switch is in the "off" position, the receiver may be operated on any channel in the normal manner without crystal control.

If a crystal unit is to be ADDED to an existing receiver, it is recommended that the unit be returned to the factory for the installation and initial adjustment.

MAINTENANCE

It must be emphasized that alignment of tuned circuits should not be attempted unless proper equipment is available. If proper equipment is not available, or if the receiver does not respond to the procedure as outlined below, it is recommended that the unit be returned to the factory for realignment. If the unit cannot be spared from service, contact the factory regarding a "loaner" or substitute unit.

EQUIPMENT REQUIRED:

Sweep generator covering television channels and IF band.

Marker generator covering 39 mc - 48 mc and television carrier frequencies. (Crystal controlled or equivalent)

Oscilloscope with 75 ohm input termination.

GENERAL DISCUSSION

Measurement and adjustment of high frequency receivers require good equipment and careful work. UNLESS PROPER PRECAUTIONS ARE TAKEN, COMPLETELY ERRONEOUS RESULTS WILL BE OBTAINED.

Elimination of Stray Feedback.

When signal generators, scopes, meters, etc., are connected to the receiver under test, these instruments and their lead cables may act as antennas, or coupled to each other through the power line, thus providing stray feedback paths. Such feedbacks must be eliminated before correct results can be obtained.

The following techniques are suggested:

a. Lay a sheet of copper or aluminum on the test bench and set the receiver under test and all equipment connected to it on the metal sheet. Ground all instruments to this common ground plane.

b. Locate signal generators connected to the input circuits on one side of the receiver, and scopes and meters connected to the output circuit on the other side of the receiver.

c. If open wire leads are used to connect an oscilloscope or voltmeter to the receiver, insert a 45 mc RF choke between the end of the test lead and the point of connection to the receiver. A 10,000 or 20,000 ohm resistor is a satisfactory substitute for the RF choke. If a coaxial cable is used to connect a laboratory grade scope, such as Tektronix, this precaution is not necessary.

e. Keep exposed ends of signal generator leads as short as practical. Ground the ends of shielded leads with short heavy conductors. This is especially important when high gain amplifiers are involved, such as in step 1.6. Long clip leads, such as are sometimes supplied with television repairmen's generators, are not suitable for accurate work.

f. Good quality signal generators are equipped with power line filters. Some inexpensive television servicemen's equipment may require an external power line filter to eliminate feedback.

Standing Waves and Terminations.

The output end of the cable from a sweep generator must always be terminated with a resistor equal to the characteristic impedance of the cable. If the cable is not properly terminated, the sweep generator output will not be flat, and incorrect alignment of the receiver will result. When possible, a resistive matching pad having a loss of from 6 to 10 db should be inserted between the sweep generator and its load. This will reduce the effect of standing waves to negligible proportions. This applies particularly to feeding the antenna terminals of the receiver.

When it is necessary to feed a marker signal generator and a sweep generator into the same point, the marker signal must be coupled in a manner which will not disturb the sweep generator termination. Usually, this can be done by attaching a short piece of insulated wire to the marker generator output cable and holding it near, or hooking it over, the receiver input point. If sufficient signal cannot be obtained this way, the marker generator must be fed in through a resistive mixer pad.

RESPONSE AT PICTURE CARRIER FREQUENCY

The response at the picture carrier frequency must be exactly 6 db below the flat top response (50% in amplitude). The curvature of the diode detector characteristic introduces a distortion which causes the picture carrier marker in a display,

such as Fig. 6, to appear to be attenuated more than it actually is. This distortion is greater for weak signals at the detector than for strong signals. For this reason, care should be taken to set levels correctly, as described in the procedure.

The correct setting of the picture carrier point on the alignment response curve can be verified by observing a multiburst pattern or window signal from a television transmitter. If the response at the picture carrier frequency is too high, the low frequency burst will be of greater amplitude than the other bursts, and the window signal will exhibit a smear or rounding off of the corner of the transient. Television pictures will lack "snap" and sharpness, even though showing full test pattern wedge resolution.

Conversely, if the response at the picture carrier frequency has been set too low, the low frequency burst of a multiburst pattern will be smaller in amplitude than the other bursts, and a window signal will exhibit excessive overshoot. Sync pulses may exhibit a spike on their trailing edges.

Complete realignment of the receiver is rarely needed unless components have been replaced or adjustments disturbed. Tuned circuits will drift slightly due to tube and component aging, producing variations in amplitude response amounting to 1 or 2 db. A simple "touch up" alignment, as described below, will usually achieve satisfactory performance.

1. TOUCH UP ALIGNMENT

1.1 Terminate the video output with a 75 ohm non-inductive resistor.

1.2 Set AGC switch to "Manual"position.
Set video level control, RF gain control and "AGC adjust" potentiometer at their maximum clockwise positions.

1.3 Set the tuner on the channel which is to be used and adjust the fine tuning to its normal position. If the receiver is to be used on all channels, set the tuner to channel 10.

1.4 Connect the sweep generator to the receiver antenna terminals, and set to the desired channel. Ascertain that the sweep generator cable is properly terminated. It will probably be necessary to operate the sweep generator near its maximum output.

1.5 A marker frequency generator, capable of producing CW signals at the required sound and picture carrier frequencies, should be loosely coupled to the antenna terminals. If there is a local television transmitter on the desired channel, it is usually possible to obtain frequency markers by holding the antenna lead-in wire near the antenna terminals.

1.6 Connect the vertical input of the scope to the test point "TP" on top of the Standard Coil tuner chassis.

1.7 Adjust C12, C13 and C16 to produce maximum amplitude of the pattern on the scope and the flattest possible response (most nearly constant amplitude) between the sound and picture carrier frequencies of the channel under test.

1.8 Move the scope to the video output jack of the receiver. Set the RF gain control of the receiver to minimum gain (full counterclockwise). Reduce the sweep generator output until the amplitude of the pattern on the scope is about 1 volt peak-to-peak. The response curve should be similar to that shown in Fig. 6, page 21.

1.9 If the pattern is tilted, it may be corrected by adjusting the bottom slug of J103, or by adjusting T101 and L8 located on top of the RF tuner chassis. If the picture carrier is not at the correct 50% down point, it may be corrected by adjusting T105, bottom, or adjusting T101, bottom, and L8 located on top of the RF tuner chassis. Check to see that the 47.25 mc trap, T109, is not seriously limiting the bandwidth.

If the correct pattern can be obtained with only minor touch-up adjustments, it can be assumed that the entire receiver is in satisfactory adjustment. If the correct pattern cannot easily be obtained with minor adjustments, a complete realignment of the receiver is indicated.

COMPLETE REALIGNMENT PROCEDURE

2. ALIGNMENT OF DETECTOR FILTER

Make set-up as described in paragraphs 1.1 and 1.2. Connect an oscilloscope to the video output jack. Connect a 75 ohm resistor across the scope input terminals. A .1 mfd capacitor may also be connected across the input terminals to "sharpen" the marks on the response curve.

2.1 Unsolder the wire from pin 1, grid, of V104/6CB6.

2.2 Connect the "IF output" of the sweep generator to pin 1 of V104 and ground. Loosely couple the marker generator to the same point.

T106, bottom, T107, top, T107, bottom, L101 and C161 should be tuned to produce a response curve, as shown in Fig. 1, page 20. The following discussion will assist in achieving this result.

The "primary" circuit, T106, bottom, is always tuned near 45 mc.

The trap, L101, is always tuned to produce a null at 41.25 mc.

The "secondary" circuit, controlled by T107, top, T107, bottom, and C161, is always tuned near 42 mc. Since there are three adjustments, an infinite number of combinations exist which will tune to the correct frequency. The problem is to find by successive approximation the combination which matches the filter to its load and thus produces the correct response curve.

2.3 Set C161 near the center of its capacitance range.

2.4 Adjust T106, bottom, to produce maximum response at 45 mc.

2.5 Adjust bottom slug of T107 to produce maximum response near 42 mc.

2.6 Adjust L101 to produce minimum response at 41.25 mc.

2.7A Observe the response curve and compare with Figures 1, 2 and 3. If there is a sharp tip at the 42 mc end of the curve, such as is shown in Figure 2, increase the inductance of the coupling coil (by turning adjustment T107, top, clockwise) and retune T107, bottom, as in step 3. Repeat steps 4 and 5 until correct response, Fig. 1, is achieved.

If maximum inductance of T107, top, is reached and the sharp tip still remains, it indicates the capacitance of C161 was set too low in step 2.3. To correct this, increase the capacitance of C161 by turning screw clockwise about 2 turns and repeat steps 2.3 through 2.7. Repeat this procedure until correct response is obtained.

If the response curve is satisfactory, except for a bulge or dome in the center, as shown in Fig. 3, reduce the capacitance of C161 slightly by turning counterclockwise approximately 2 turns and retune T107, bottom.

2.7B The converse relations are also true. If in step 2.7A an excessive roll-off near 41.75 mc is noted, instead of a sharp tipped rise, the inductance of T107, top, should be decreased and T107, bottom, retuned. Also, if the response curve has a dip in response near its center frequency, the capacity of C161 should be increased (turn adjustment clockwise) and steps 2.3 to 2.7 repeated.

This process can be speeded up considerably using two adjustment wrenches, one in each hand, and simultaneously tuning the top and bottom slugs of T107. With proper alignment, the 45 mc response and the 41.75 mc response should be not more than 1 db below the flat top response level.

2.8 Restore the connection between the grid, pin 1, of V104/6CB6 and T105.

3. ALIGNMENT OF STAGGER TUNED TRIPLE, T103, T104 AND T105

Set AGC switch to manual position. Set RF level control to position at which the bias on the IF stage is approximately -3 volts.

3.1 Temporarily unsolder the connection between the grid, pin 1, of V101/6BZ6 and T101.

3.2 Connect the sweep generator to pin 1 of V101 through a 470 mmf capacitor.

3.3 Loosely couple the marker generator to pin 1 of V101. Set IF AGC voltage to -2.5 or -3 volts.

3.4 Adjust the sweep generator output level to produce a pattern on the scope having an amplitude of 1 volt peak-to-peak.

3.5 Adjust the bottom slug of T103 to produce maximum response at 43 mc.

3.6 Adjust T104, bottom, to produce maximum response at 42 mc.

3.7 Adjust T105, bottom, to produce maximum response at 45 mc.

3.8 Adjust T109 and T105, top, for minimum response at 47.25 mc.

3.9 Adjust T104, top, for minimum response at 39.75 mc.

3.10 Touch up the bottom slugs of T103, T104 and T105 to produce a response curve as shown in Fig. 4.

The trap adjustments must always be checked after associated coils have been readjusted.

3.11 Restore the connection between pin 1 of V101/6BZ6 and T101.

4. ALIGNMENT OF CONVERTER TO IF COUPLING NETWORK

4.1 Set station selector between channels. Connect the sweep generator, through a 470 mmf (approximately) ceramic disc capacitor, to the test point on the station selector. Apply a 1.5 volt negative bias to the test point through a 10,000 ohm, decoupling resistor.

4.2 Adjust the sweep generator level to produce approximately 1 volt peak-to-peak at the output of the receiver.

4.3 Loosely couple the marker generator to the mixer grid terminal.

4.4 Adjust T101 for maximum response at 45 mc.

4.5 Adjust L8 for maximum response at 42 mc.

4.6 Adjust T102 for minimum response at 41.25 mc.

4.7 Repeat steps 4.4, 4.5 and 4.6 until the response is similar to that shown in Fig. 5.

TUNER ALIGNMENT - See Section 1.1 through 1.7

5. VIDEO AMPLIFIER ADJUSTMENT

Use a scope which is flat in response to beyond 4.1 mc. Remove the capacitor described in Section 2 from the input terminals.

5.1 Unsolder one end of the crystal diode, CR1. CAUTION: Grasp the crystal lead wire between the crystal and the joint to be unsoldered with a pair of long pliers. Unsolder the connection; wait a few seconds before releasing the pliers. This procedure prevents heat from the soldering iron from damaging the crystal junction.

5.2 Connect a crystal controlled 4.5 mc generator through a 3900 ohm composition resistor to the junction of C116 and L103.

5.3 Adjust L104 to produce minimum output at J3 and J4.

5.4 Disconnect the 4.5 mc generator and connect the video sweep generator through a 3900 ohm composition resistor to the junction of C116 and L103.

5.5 Adjust L108 and C134 to produce a video response curve which is flat from 0 to 4.1 mc.

ALTERNATE METHOD OF SETTING L104 (4.5 mc Trap)

Set up the receiver for normal reception and tune in a television station. Connect an oscilloscope to the output jack, J3 or J4, and adjust sweep to view a horizontal sync pulse. Detune the fine tuning adjustment of the receiver in the direction to produce sound carrier interference in the picture. This is visible as a "fuzz" (4.5 mc beat) on the sync pulse display on the scope.

Adjust L104 to produce minimum fuzz on the scope display.

6. OVER-ALL PERFORMANCE CHECK

6.1 Single Sideband Sweep Method

Set up the receiver as described in paragraphs 1.1, 1.2 and 1.3. The fine tuning must be set very accurately. One method of doing this is to feed the receiver with a signal generator tuned to the sound carrier frequency of the desired channel and modulated (approximately 30%) with an audio tone.

Observe the output of the receiver with an oscilloscope connected to J3 or J4.

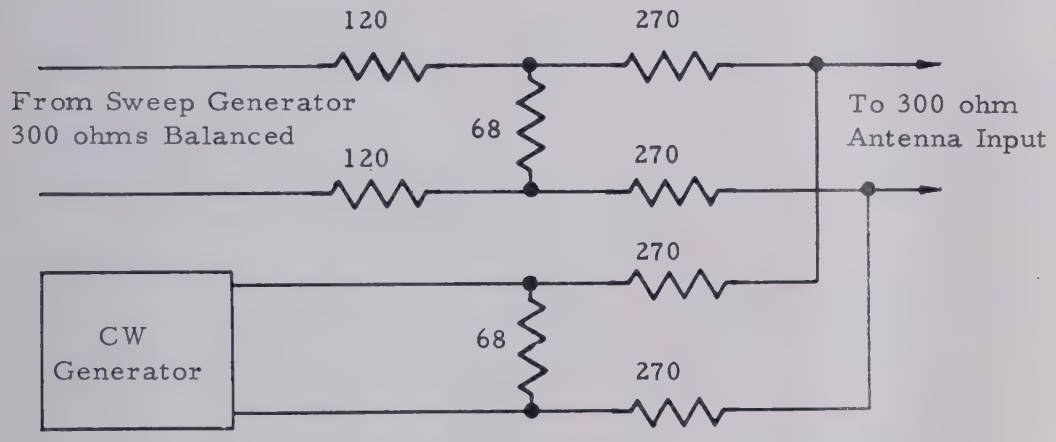
As the fine tuning is adjusted, a sharp null will be noted in the output level when this signal is in the bottom of the "sound notch" produced by the 41.25 mc traps. Set the fine tuning at this null point.

Connect the sweep generator and a CW signal generator, accurately tuned to the picture carrier frequency, to the receiver antenna terminals through a resistive matching pad, as sketched on page 17.

With the CW generator turned off, adjust the sweep generator output to produce approximately 2/10 volt peak-to-peak sweep pattern at J3 and J4.

Turn on the CW generator and adjust its level until a sweep envelope pattern with an amplitude of approximately 1 volt appears on the scope. The response should be flat from about 1 mc to over 4 mc, as shown in Fig. 7. Switching off the CW generator permits viewing the over-all RF-IF response, as shown in Fig. 6.

If the video response is not flat, L108 and C134 should be adjusted for best response. The RF-IF adjustments, described in paragraph 1.9, may also be adjusted to produce flattest response curve and to place the picture carrier at its correct 50% point. With proper equipment and techniques this method gives a more accurate adjustment of the video peaking than the direct method given in Section 5.



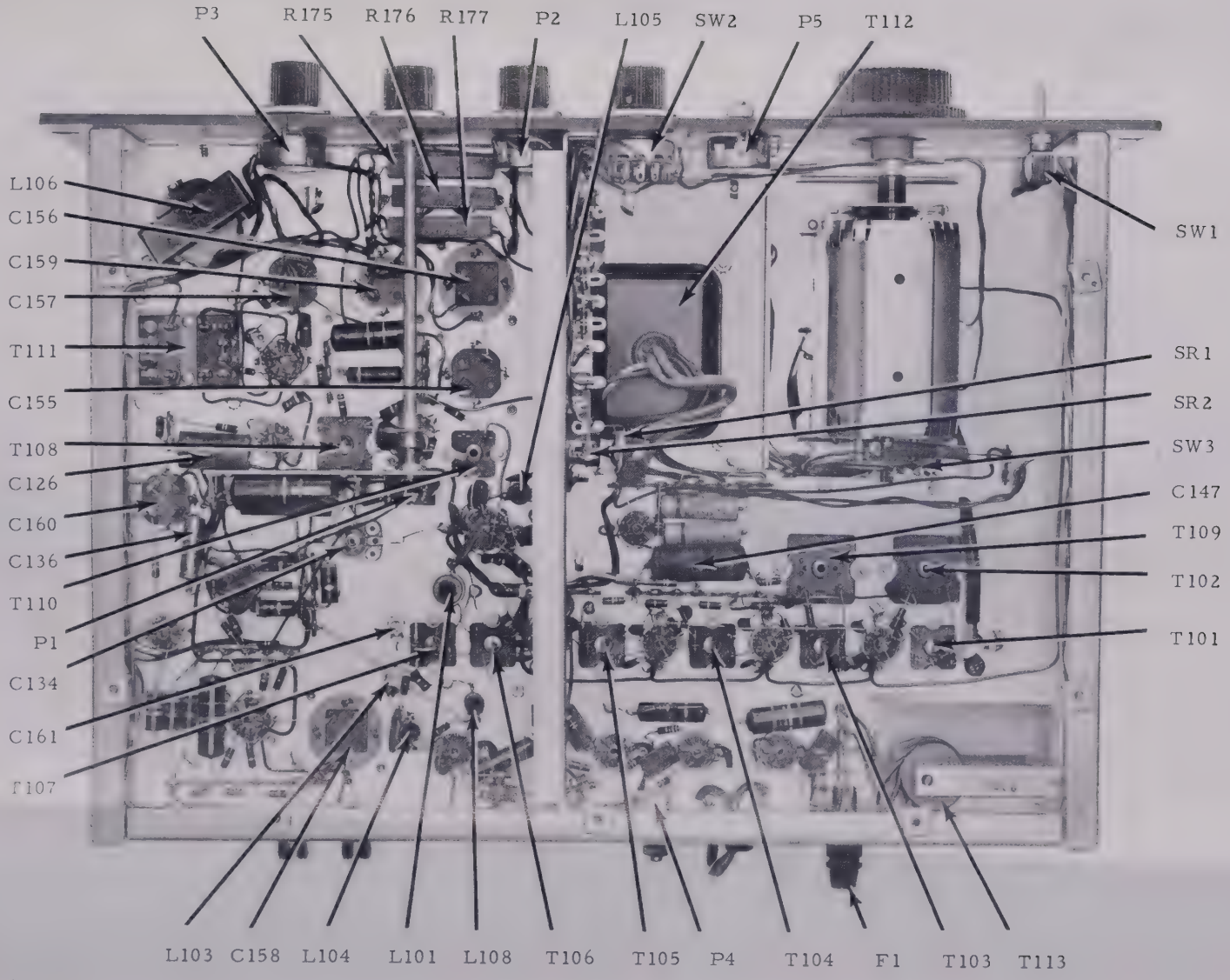
RESISTIVE MATCHING PAD
Values are in ohms.
Resistors must be non-inductive.

ALTERNATE OVER-ALL CHECK

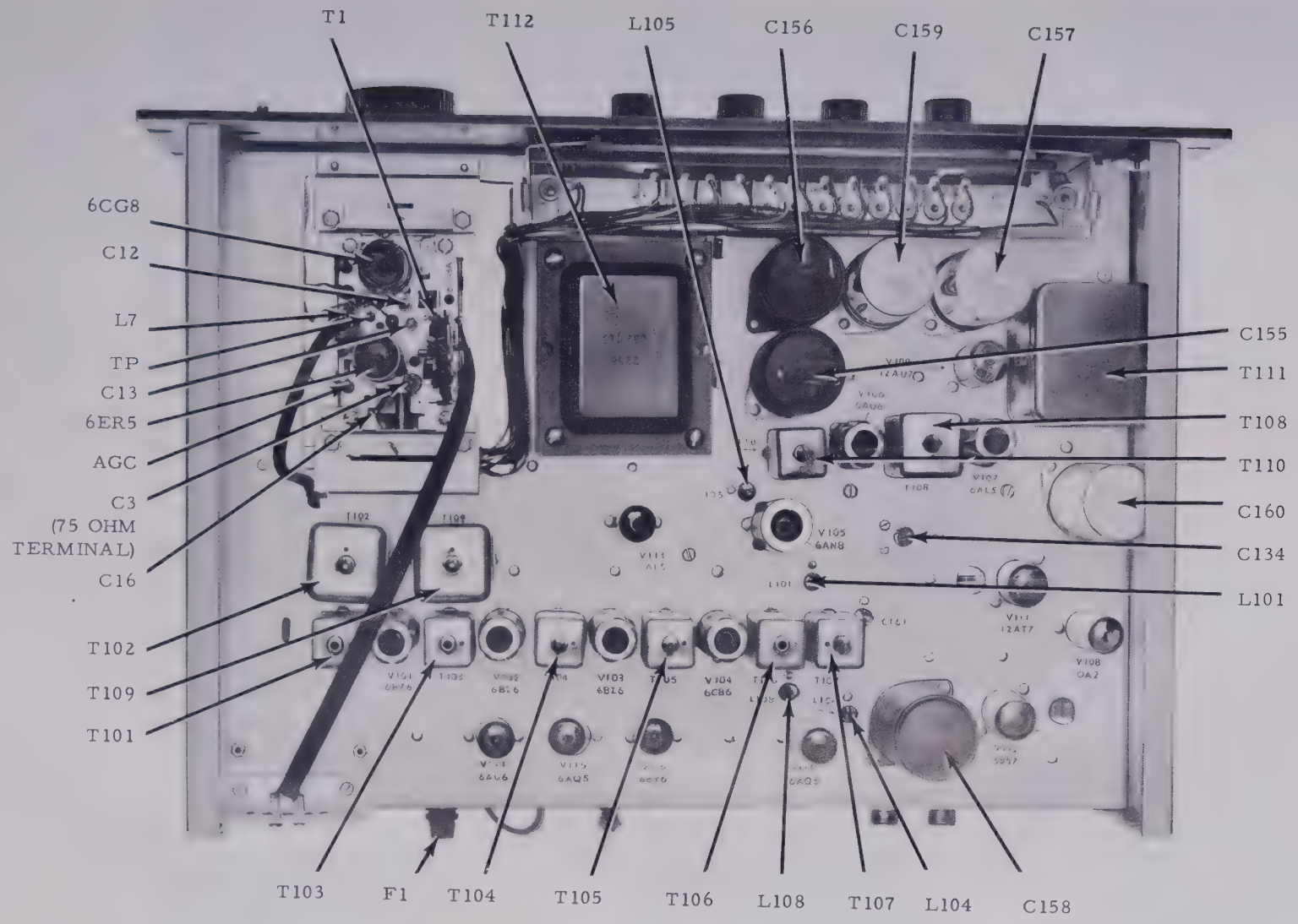
When possible, it is recommended that the receiver be tested with a video transmitter, as described under PERFORMANCE CHECK on page 7.

OC CRYSTAL UNIT ALIGNMENT

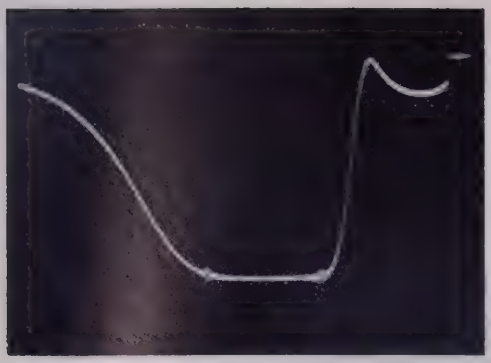
Alignment of the OC series Crystal Control Unit consists of adjusting the tuned circuits to the frequencies indicated in the frequency tables, pages 25 and 27. Connect a vacuum tube voltmeter to TP1 through a 470,000 ohm isolation resistor. Adjust L1 for maximum negative voltage. Move the voltmeter probe to TP2 and adjust L2 for maximum negative voltage. Recheck L1. Make a crystal rectifier "probe", as shown on drawing 1406, page 25, and connect it to the output jack. Adjust L3, L4 and C8 for maximum voltage. If necessary, L1 can be readjusted to the exact frequency required. Models OC2 through OC6 do not contain L4 or C8.



MODEL AV12D, BOTTOM VIEW

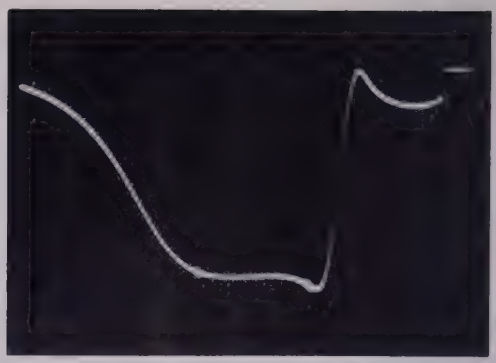


MODEL AV12D, TOP VIEW



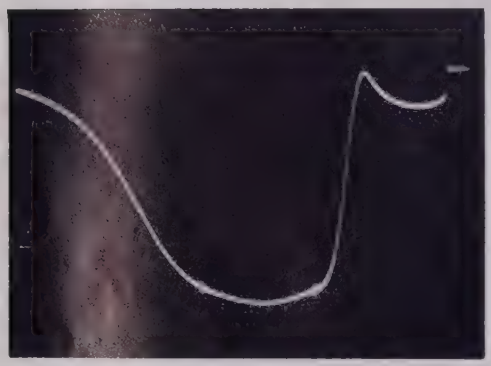
45 MC 42 MC

Fig. 1: V104 Grid to Output
CORRECT ALIGNMENT



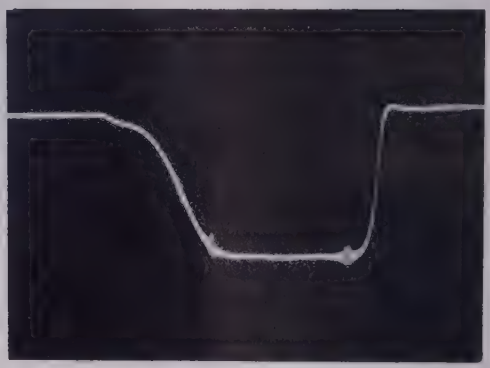
45 MC 42 MC

Fig. 2: V104 Grid to Output
INCORRECT ALIGNMENT
Sharp tip at 42 mc



45 MC 42 MC

Fig. 3: V104 Grid to Output
INCORRECT ALIGNMENT
"Domed" Center



45 MC 42 MC

Fig. 4: V101 Grid to Output
CORRECT ALIGNMENT

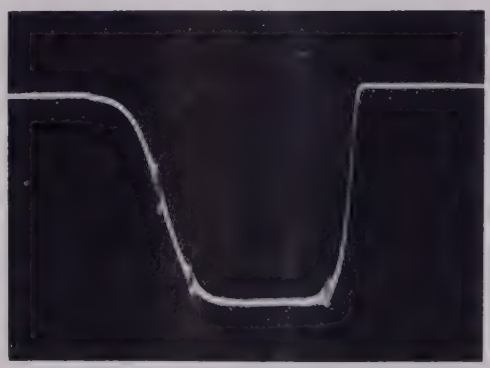
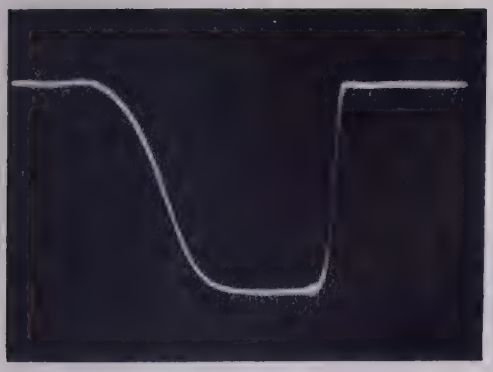


Fig. 5: Mixer Grid to Output
CORRECT ALIGNMENT



45.75mc 42mc
Fig. 6: OVERALL RF-IF RESPONSE

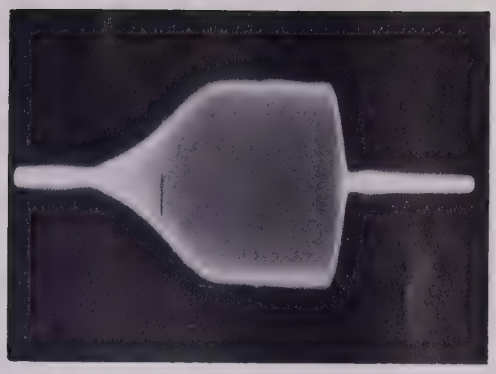
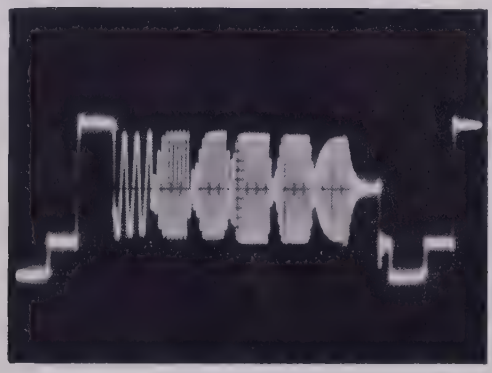


Fig. 7: SINGLE SIDEBAND RESPONSE
of Entire System



.5mc 4.1mc
Fig. 8: Multiburst Display Channel 6 Megapix Transmitter
Modulated with Telechrome Multiburst Generator
Bursts are .5, 1.5, 2.5, .3, 3.6, 4.1mc

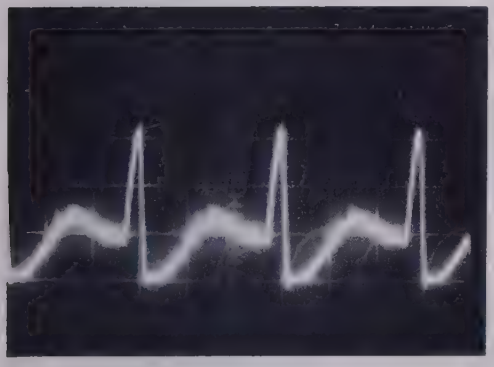


Fig. 9: AGC KEYING PULSE
V114 Plate
500 Volts/CM

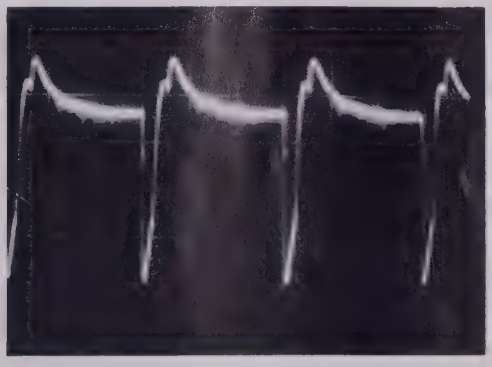


Fig. 10: AGC KEYING PULSES
V115 Grid
5 Volts/CM

VOLTAGE TABLE

AGC Switch in "Normal" AGC Position

Input Signal - 10,000 Microvolts - Channel 6
Input Power - 117 Volts - 80 Watts
Video Output - 1.4 Volts - Peak-to-Peak

B+ Voltages:

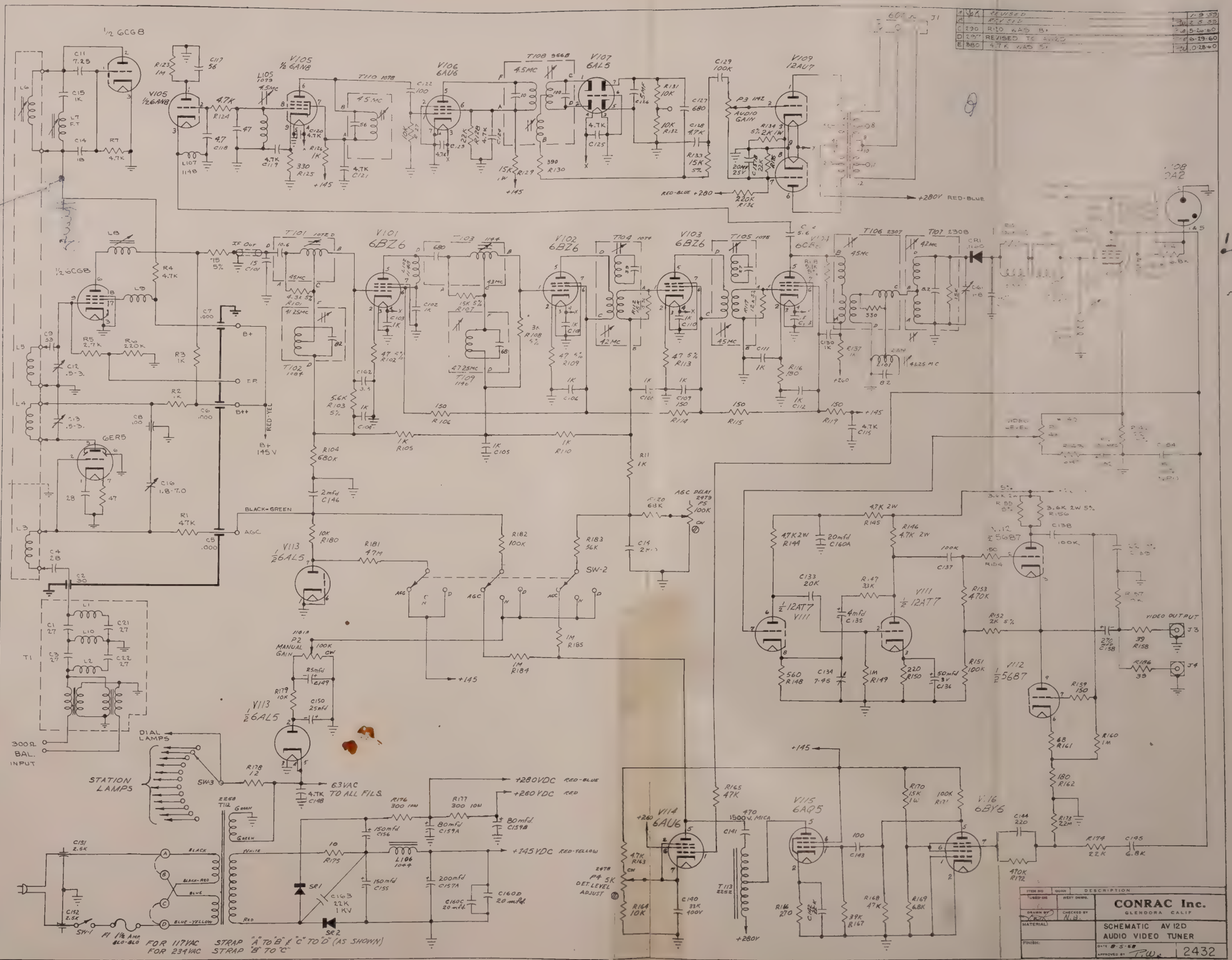
Red-Blue Wires	280 Volts
Red Wire	265 Volts
Red-Yellow Wires	135 Volts

PIN	1	2	3	4	5	6	7	8	9
V101/6BZ6	-2.43	.26	G	H	126	126	G		
V102/6BZ6	-2.35	.26	G	H	126	126	G		
V103/6BZ6	-2.35	.4	G	H	127	128	G		
V104/6CB6	0	1.8	G	H	252	132	G		
V105/6AN8	-5	-2.65	0	H	G	129	129	0	2.13
V106/6AU6	-.65	G	H	G	51	52	G		
V107/6AL5	-7.9	-7.1	G	H	G	G	-12.25		
V108/OA2	145	G			145				
V109/12AU7	278	28	36	H	H	278	28.4	36	G
V110/6AQ5	-1.3	4.4	H	G	76	131			
V111/12AT7	218	0	1.9	H	H	165	4.4	5.4	G
V112/5687	206	78	103	H	H	6.4	4.1	G	103
V113/6AL5	G	-8.5	G	H	H	G	-4.55		
V114/6AU6	76	86	H	G	-40	89	86		
V115/6AQ5	-.05	6.6	H	G	280	135			
V116/6BY6	G	G	H	G	38	23.5	-.58		

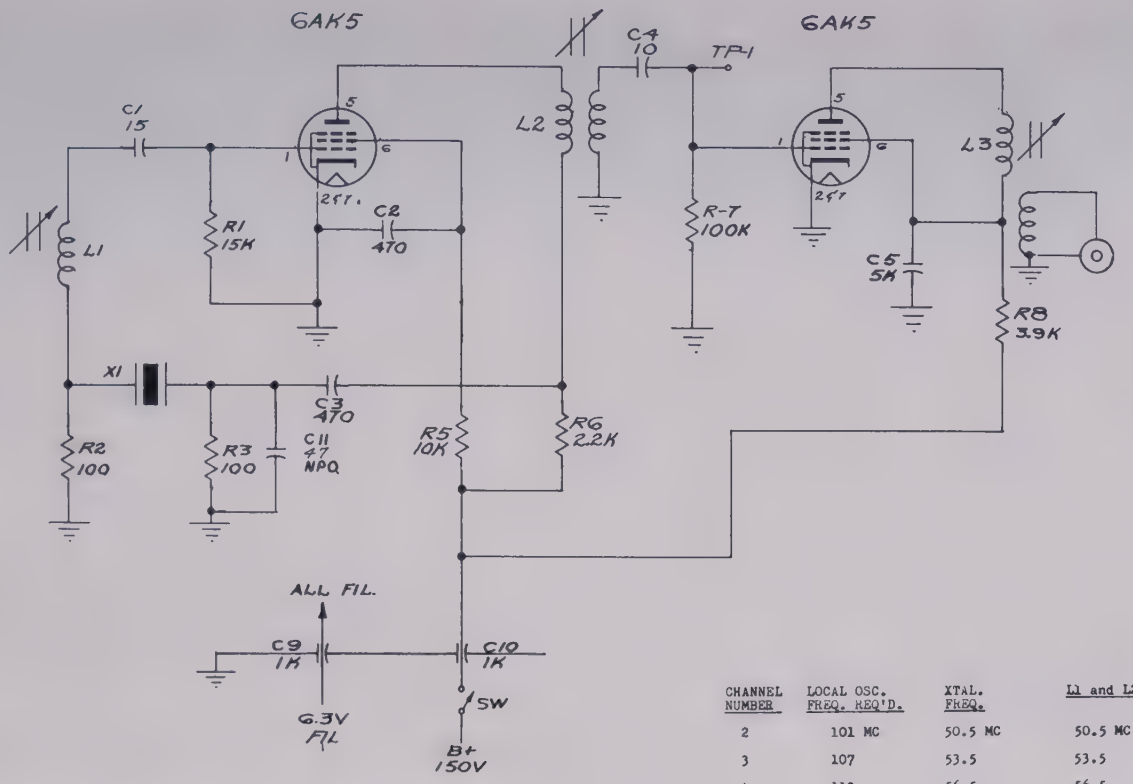
All measurements made with
Vacuum Tube Voltmeter

G = Ground
H = 6.3V A.C.

Tuner Std Coil
GG-4393



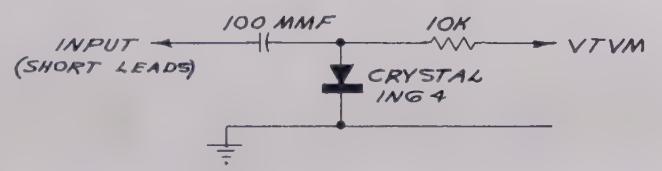
A	185	ADDED C11 - DELETED R4	PW 10-22-57
B	191	C11 4145 50	PW 1-9-57



1406

CHANNEL NUMBER	LOCAL OSC. FREQ. REQ'D.	XTAL. FREQ.	L1 and L2	L3
2	101 MC	50.5 MC	50.5 MC	101
3	107	53.5	53.5	107
4	113	56.5	56.5	113
5	123	61.5	61.5	123
6	129	64.5	64.5	129

L1 TUNING RANGE 47MC TO 70MC
L2 TUNING RANGE 42MC TO 68 MC
L3 TUNING RANGE 95MC TO 140 MC



VOLTMETER "PROBE" FOR
TEST AND ALIGNMENT

ITEM NO.	QUAN.	DESCRIPTION
USED ON	NEXT DRWG.	
DRAWN BY: H.W.	CHECKED BY:	
MATERIAL:		
FINISH:		

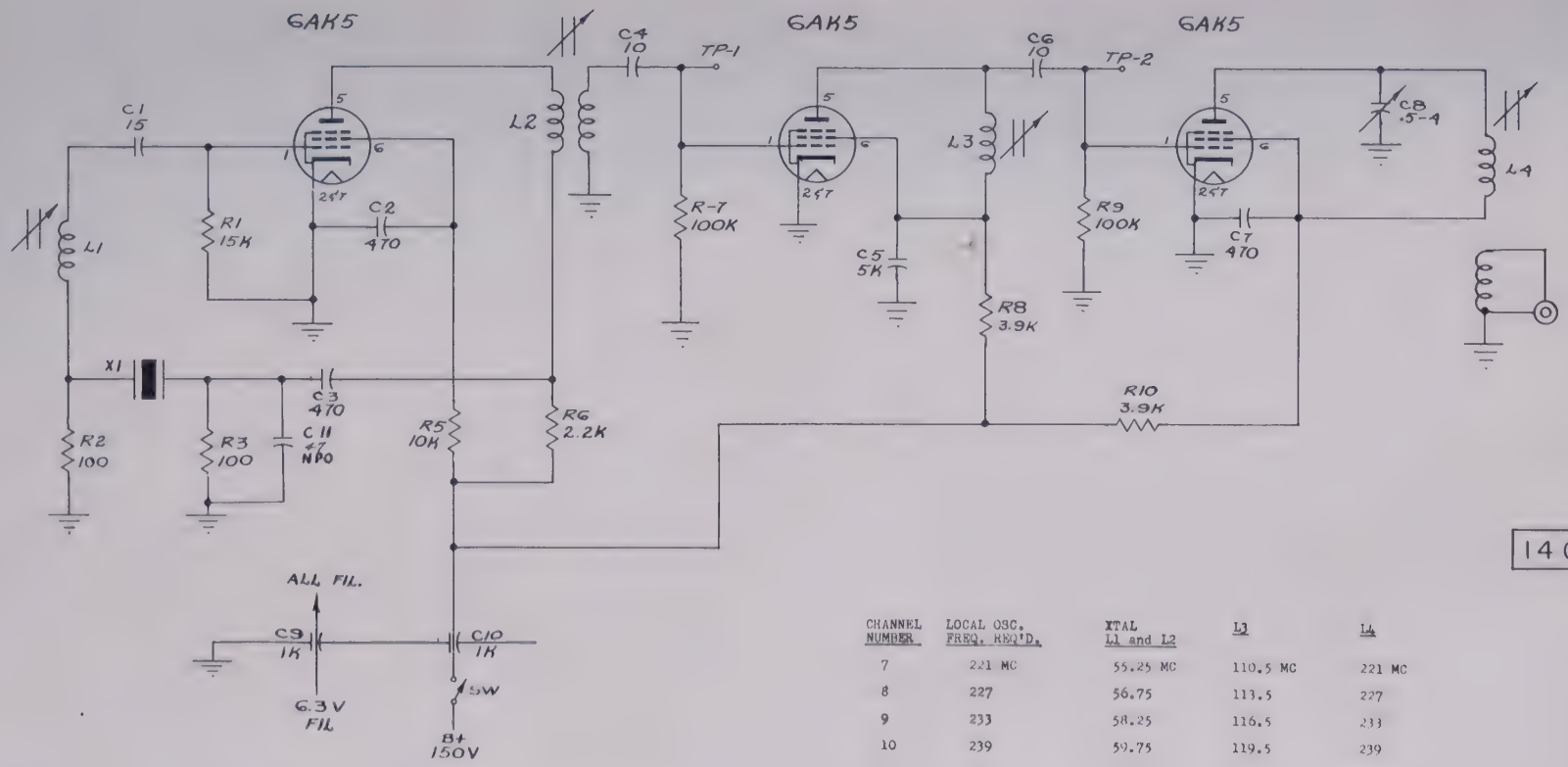
CONRAC Inc.
GLENDORA, CALIF.

OC 2-6
CRYSTAL UNIT

DATE 12-7-56
APPROVED BY:

1406

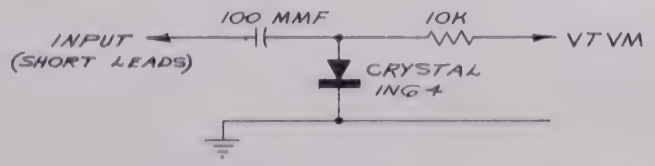
A	185	ADDED C11 • DELETED R4	10-22-57
B	191	C11 WAS 50	1-3-58



1405

CHANNEL NUMBER	LOCAL OSC. FREQ. REQ'D.	XTAL L1 and L2	L3	L4
7	221 MC	55.25 MC	110.5 MC	221 MC
8	227	56.75	113.5	227
9	233	58.25	116.5	233
10	239	59.75	119.5	239
11	245	61.25	122.5	245
12	251	62.75	125.5	251
13	257	64.25	128.5	257

L1 TUNING RANGE 47MC TO 70MC
L2 TUNING RANGE 48MC TO 68MC
L3 TUNING RANGE 95MC TO 140MC
L4 TUNING RANGE 221MC TO 257MC



VOLTMETER "PROBE" FOR TEST AND ALIGNMENT

ITEM NO.	QUAN.	DESCRIPTION
USED ON	NEXT DRWG.	
DRAWN BY: H.J.	CHECKED BY:	
MATERIAL:		
FINISH:		

CONRAC Inc.
GLENDORA, CALIF

OC 7-13
CRYSTAL UNIT

DATE 12 7 55
APPROVED BY

1405

REPLACEABLE PARTS - MODEL OC CRYSTAL CONTROL UNIT

SYMBOL	DESCRIPTION	PART NO.	MFR.*
	CAPACITORS		
C1	Cer. Disc, NPO, 15 mmf, 500 V		MU
C2	Cer. Disc, G.P., 470 mmf, 500 V		MU
C3	Cer. Disc, 470 mmf, 500 V		MU
C4	Cer. Disc, NPO, 10 mmf, 500 V		MU
C5	Cer. Disc, G.P., 5000 mmf, 500 V		MU
C6	Cer. Disc, NPO, 10 mmf, 500 V (OC 7-13 Only)		MU
C7	Cer. Disc, G.P., 470 mmf, 500 V (OC 7-13 Only)		MU
C8	Trimmer, Tubular (OC 7-13 Only)	532-08	ER
C9	Cer. Feedthrough, 1000 mmf, 500 V	MFT-1000	CRL
C10	Cer. Feedthrough, 1000 mmf, 500 V	MFT-1000	CRL
C11	Cer. Disc, NPO, 47 mmf, 500 V	36-4701	AB
	COILS		
L1	Slug Tuned	1410	CONRAC
L2	Slug Tuned	1409	CONRAC
L3	Slug Tuned (OC 2-6 Only)	1417	CONRAC
L3	Slug Tuned (OC 7-13 Only)	1257	CONRAC
L4	Slug Tuned (OC 7-13 Only)	1258	CONRAC
	RESISTORS		
R1	Composition, 15,000 ohms, 10%, 1/2 w		AB
R2	Composition, 100 ohms, 10%, 1/2 w		AB
R3	Composition, 100 ohms, 10%, 1/2 w		AB
R5	Composition, 10,000 ohms, 10%, 1/2 w		AB
R6	Composition, 2200 ohms, 10%, 1/2 w		AB
R7	Composition, 100,000 ohms, 10%, 1/2 w		AB
R8	Composition, 3900 ohms, 10%, 1/2 w		AB
R9	Composition, 100,000 ohms, 10%, 1/2 w (OC 7-13 Only)		AB
R10	Composition, 3900 ohms, 10%, 1/2 w (OC 7-13 Only)		AB
	CRYSTAL		
X1	Quartz (Specify Frequency)	CR23/U	MP
	VACUUM TUBES		
V3	6AK5		
V4	6AK5		
V5	6AK5 (OC 7-13 Only)		

*See Manufacturers List, Page 34.

SYMBOL	DESCRIPTION	PART NO.	MFR.*
	CAPACITORS		
C101	Cer. Disc, NPO, 15 mmf, 10%, 500 V		MU
C102	Cer. Disc, 1000 mmf, 500 V	16-1022	AB
C103	Cer. Disc, 1000 mmf, 500 V	16-1022	AB
C104	Cer. Disc, 1000 mmf, 500 V	16-1022	AB
C105	Cer. Disc, 1000 mmf, 500 V	16-1022	AB
C106	Cer. Disc, 1000 mmf, 500 V	16-1022	AB
C107	Cer. Disc, 1000 mmf, 500 V	16-1022	AB
C108	Cer. Disc, 1000 mmf, 500 V	16-1022	AB
C109	Cer. Disc, 1000 mmf, 500 V	16-1022	AB
C110	Cer. Disc, 1000 mmf, 500 V	16-1022	AB
C111	Cer. Disc, 1000 mmf, 500 V	16-1022	AB
C112	Cer. Disc, 1000 mmf, 500 V	16-1022	AB
C113	Cer. Disc, 1000 mmf, 500 V	16-1022	AB
C114	Cer. Tub., NPO, 5.6 mmf, 500 V		MU
C115	Cer. Disc, 4700 mmf, 500 V	L36AGD4722YU	AB
C116	Cer. Tub., NPO, 4.7 mmf, 500 V		MU
C117	Cer. Tub., 56 mmf, 10%, 500 V		MU
C118	Cer. Tub., NPO, 4.7 mmf, 500 V		MU
C119	Cer. Disc, 4700 mmf, 500 V	L36AGD4722YU	AB
C120	Cer. Disc, 4700 mmf, 500 V	L36AGD4722YU	AB
C121	Cer. Disc, 4700 mmf, 500 V	L36AGD4722YU	AB
C122	Cer. Tub., G.P., 100 mmf, 500 V		MU
C123	Cer. Disc, 4700 mmf, 500 V	L36AGD4722YU	AB
C124	Cer. Disc, 4700 mmf, 500 V	L36AGD4722YU	AB
C125	Cer. Disc, 4700 mmf, 500 V	L36AGD4722YU	AB
C126	Electrolytic, 5 mfd, 50 V	BR-550T	CD
C127	Cer. Tub., 680 mmf, 10%, 500 V		MU
C128	Paper, 4700 mmf, 20%, 600 V	73P47206	SP
C129	Paper, 100,000 mmf, 20%, 400 V	67P10404	SP
C130	Cer. Disc, 1000 mmf, 500 V	16-1022	AB
C132	Electrolytic, 100 mfd, 15 V	BBR-100-15T	CD
C133	Cer. Disc, 20,000 mmf, 500 V	DD-203	CRL
C134	Trimmer, 7-45 mmf	TS2A-N500	ER
C135	Electrolytic, 4 mfd, 450 V	BR-445T	CD
C136	Electrolytic, 50 mfd, 3 V	BBR-50-3	CD
C137	Paper, 100,000 mmf, 20%, 600 V	73P10406	SP
C138	Paper, 100,000 mmf, 20%, 400 V	67P10404	SP
C139	Cer. Disc, 22 mmf, 10%, 500 V		MU
C140	Paper, 33,000 mmf, 20%, 400 V	67P33304	SP
C141	Mica, 470 mmf, 10%, 1500 V	VCM20B471K	ELM
C142	Paper, 22,000 mmf, 20%, 400 V	67P22304	SP
C143	Mica, 100 mmf, 20%, 600 V	CM20B101M	ELM
C144	Mica, 220 mmf, 20%, 600 V	CM20B221M	ELM
C145	Paper, 6800 mmf, 20%, 600 V	73P68206	SP

*See Manufacturers List, Page 34.

SYMBOL	DESCRIPTION	PART NO.	MFR.*
	CAPACITORS (Continued)		
C146	"Metalized" Paper, 2 mfd, 200 V	P82	AVX
C147	"Metalized" Paper, 2 mfd, 200 V	P82	AVX
C148	Cer. Disc, 4700 mmf, 500 V	L36AGD4722YU	AB
C149	Electrolytic, 25 mfd, 25 V	BR-252A	CD
C150	Electrolytic, 25 mfd, 25 V	BR-252A	CD
C151	Cer. Feedthrough, 2500 mmf, 500 V	FIS	AB
C152	Cer. Feedthrough, 2500 mmf, 500 V	FIS	AB
C154	Cer. Disc, NPO, 15 mmf, 10%, 500 V		MU
C155	Electrolytic, 150 mfd, 200 V	UPE-15020T	CD
C156	Electrolytic, 150 mfd, 200 V	UPE-15020T	CD
C157	Electrolytic, 200 mfd, 200 V, 20 mfd, 25 V	1290	CONRAC
C158	Electrolytic, 270 mfd, 200 V	1291	CONRAC
C159	Electrolytic, 80-80 mfd, 300 V	1289	CONRAC
C160	Electrolytic, 20-20-20-20 mfd, 450 V	UP-222245	CD
C161	Trimmer, 1-8 mmf	532	ER
C162	Cer. Tub., 3.3 mmf, 10%, 500 V	Type QC	QC
	COILS		
L101	41.25 mc Trap	2704	CONRAC
L102	45 mc R.F. Choke	1148	CONRAC
L103	Peaking	2339	CONRAC
L104	4.5 mc Trap	2337	CONRAC
L105	4.5 mc	1079	CONRAC
L106	Filter Choke	1044	CONRAC
L107	45 mc R.F. Choke	1148	CONRAC
L108	Peaking	2453	CONRAC
	POTENTIOMETERS		
P1	Composition, 4000 ohms, (Video Level)	1140	CONRAC
P2	Composition, 100,000 ohms, (Manual Gain)	1141A	CONRAC
P3	Composition, 500,000 ohms, (Audio Gain)	1142	CONRAC
P4	Composition, 5000 ohms, (Det. Level)	2478	CONRAC
P5	Composition, 100,000 ohms, (AGC Delay)	2479	CONRAC
	RECTIFIERS		
CR1	Diode, Crystal	1N60	SYL
SR1	Power, Silicon	SD95A	IR
SR2	Power, Silicon	SD95A	IR
	RESISTORS		
R101	Composition, 4300 ohms, 5%, 1/2 w		AB
R102	Composition, 47 ohms, 5%, 1/2 w		AB
R103	Composition, 5600 ohms, 5%, 1/2 w		AB
R104	Composition, 680,000 ohms, 10%, 1/2 w		AB

*See Manufacturers List, Page 34.

SYMBOL	DESCRIPTION	PART NO.	MFR.*
	RESISTORS (Continued)		
R105	Composition, 1000 ohms, 10%, 1/2 w		AB
R106	Composition, 150 ohms, 10%, 1/2 w		AB
R107	Composition, 15,000 ohms, 5%, 1/2 w		AB
R108	Composition, 3000 ohms, 5%, 1/2 w		AB
R109	Composition, 47 ohms, 5%, 1/2 w		AB
R110	Composition, 1000 ohms, 10%, 1/2 w		AB
R111	Composition, 1000 ohms, 10%, 1/2 w		AB
R112	Composition, 15,000 ohms, 5%, 1/2 w		AB
R113	Composition, 47 ohms, 5%, 1/2 w		AB
R114	Composition, 150 ohms, 10%, 1/2 w		AB
R115	Composition, 150 ohms, 10%, 1/2 w		AB
R116	Composition, 180 ohms, 10%, 1/2 w		AB
R117	Composition, 12,000 ohms, 5%, 1/2 w		AB
R118	Composition, 5100 ohms, 5%, 1/2 w		AB
R119	Composition, 150 ohms, 10%, 1/2 w		AB
R120	Composition, 68,000 ohms, 10%, 1/2 w		AB
R121	Composition, 9100 ohms, 5%, 1/2 w		AB
R122	Composition, 3300 ohms, 5%, 1/2 w		AB
R123	Composition, 1 megohm, 10%, 1/2 w		AB
R124	Composition, 4700 ohms, 10%, 1/2 w		AB
R125	Composition, 330 ohms, 10%, 1/2 w		AB
R126	Composition, 1000 ohms, 10%, 1/2 w		AB
R127	Composition, 10,000 ohms, 10%, 1/2 w		AB
R128	Composition, 22,000 ohms, 10%, 1/2 w		AB
R129	Composition, 15,000 ohms, 10%, 1 w		AB
R130	Composition, 390 ohms, 10%, 1/2 w		AB
R131	Composition, 10,000 ohms, 10%, 1/2 w		AB
R132	Composition, 10,000 ohms, 10%, 1/2 w		AB
R133	Composition, 15,000 ohms, 5%, 1/2 w		AB
R134	Composition, 2000 ohms, 5%, 1 w		AB
R135	Composition, 22,000 ohms, 10%, 1/2 w		AB
R136	Composition, 220,000 ohms, 10%, 1/2 w		AB
R137	Composition, 1000 ohms, 10%, 1/2 w		AB
R138	Composition, 3300 ohms, 10%, 2 w		AB
R139	Composition, 6800 ohms, 10%, 1/2 w		AB
R140	Composition, 18,000 ohms, 10%, 2 w		AB
R141	Composition, 6800 ohms, 10%, 1/2 w		AB
R142	Composition, 220 ohms, 5%, 1/2 w		AB
R143	Composition, 680 ohms, 10%, 1/2 w		AB
R144	Composition, 4700 ohms, 10%, 2 w		AB
R145	Composition, 4700 ohms, 10%, 2 w		AB
R146	Composition, 4700 ohms, 10%, 2 w		AB
R147	Composition, 3300 ohms, 10%, 1/2 w		AB
R148	Composition, 560 ohms, 10%, 1/2 w		AB
R149	Composition, 1 megohm, 10%, 1/2 w		AB

*See Manufacturers List, Page 34.

SYMBOL	DESCRIPTION	PART NO.	MFR.*
	RESISTORS (Continued)		
R150	Composition, 220 ohms, 10%, 1/2 w		AB
R151	Composition, 100,000 ohms, 10%, 1/2 w		AB
R152	Composition, 2000 ohms, 5%, 1/2 w		AB
R153	Composition, 470,000 ohms, 10%, 1/2 w		AB
R154	Composition, 150 ohms, 10%, 1/2 w		AB
R155	Composition, 3600 ohms, 5%, 2 w		AB
R156	Composition, 3600 ohms, 5%, 2 w		AB
R157	Composition, 10,000 ohms, 10%, 1/2 w		AB
R158	Composition, 39 ohms, 10%, 1/2 w		AB
R159	Composition, 150 ohms, 10%, 1/2 w		AB
R160	Composition, 1 megohm, 10%, 1/2 w		AB
R161	Composition, 68 ohms, 10%, 1/2 w		AB
R162	Composition, 180 ohms, 10%, 1/2 w		AB
R163	Composition, 4700 ohms, 10%, 1/2 w		AB
R164	Composition, 10,000 ohms, 10%, 1/2 w		AB
R165	Composition, 47,000 ohms, 10%, 1/2 w		AB
R166	Composition, 270 ohms, 10%, 1/2 w		AB
R167	Composition, 39,000 ohms, 10%, 1/2 w		AB
R168	Composition, 47,000 ohms, 10%, 1/2 w		AB
R169	Composition, 6800 ohms, 10%, 1/2 w		AB
R170	Composition, 15,000 ohms, 10%, 1 w		AB
R171	Composition, 100,000 ohms, 10%, 1/2 w		AB
R172	Composition, 470,000 ohms, 10%, 1/2 w		AB
R173	Composition, 2.2 megohms, 10%, 1/2 w		AB
R174	Composition, 22,000 ohms, 10%, 1/2 w		AB
R175	Wire Wound, 10 ohms, 10%, 10 w	PW10	IRC
R176	Wire Wound, 300 ohms, 10%, 10 w	PW10	IRC
R177	Wire Wound, 300 ohms, 10%, 10 w	PW10	IRC
R178	Wire Wound, 1.2 ohms, 10%, 1 w	BW-1	IRC
R179	Composition, 10,000 ohms, 10%, 1/2 w		AB
R180	Composition, 10,000 ohms, 10%, 1/2 w		AB
R181	Composition, 4.7 megohms, 10%, 1/2 w		AB
R182	Composition, 100,000 ohms, 10%, 1/2 w		AB
R183	Composition, 56,000 ohms, 10%, 1/2 w		AB
R184	Composition, 1 megohm, 10%, 1/2 w		AB
R185	Composition, 1 megohm, 10%, 1/2 w		AB
R186	Composition, 39 ohms, 10%, 1/2 w		AB
	TRANSFORMERS		
T101	Bifilar	1072	CONRAC
T102	41.25 mc Trap	1084	CONRAC
T103	Bifilar	1144	CONRAC
T104	I.F.	1074	CONRAC
T105	I.F.	1075	CONRAC
T106	Detector Input	2307	CONRAC
T107	Detector Filter	2308	CONRAC

*See Manufacturers List, Page 34.

REPLACEABLE PARTS - MODEL AV12D RECEIVER

SYMBOL	DESCRIPTION	PART NO.	MFR.*
	TRANSFORMERS (Continued)		
T108	Ratio Detector	956B	CONRAC
T109	47.25 mc Trap	1146	CONRAC
T110	4.5 mc	1078	CONRAC
T111	Audio	16448-Q	PRL
T112	Power	2258	CONRAC
T113	Pulse	2252	CONRAC
	MISCELLANEOUS		
	Bezel	1112	CONRAC
	Channel Tabs	770	CONRAC
	Extractor Fuse Post	342012	LF
F1	Fuse: 1.5 amp. Slo-Blo	31301.5	LF
	Green Filter	1958	CONRAC
	Knobs: Audio Level, Video Level, etc.	3044	CONRAC
	Knob: Channel Selector	3045	CONRAC
	Knob: Fine Tuning	1208	CONRAC
	Line Cord, Brown	CS-206Q	PH
	Standard Coil Tuner, Neutrode Type GG	980002	CONRAC
SW1	Switch: Toggle	1802	CONRAC
SW2	Switch: Rotary, 4 Poles, 3 Positions	2469	CONRAC
SW3	Switch Wafer	1081	CONRAC
	Tuner Dial (Glass)	997	CONRAC

*See Manufacturers List Below.

CODE LETTERS - MANUFACTURERS OF REPLACEABLE PARTS

CODE	MANUFACTURERS	LOCATION
AB	Allen-Bradley Co.	Milwaukee 4, Wisconsin
AVX	Aerovox Corp.	New Bedford, Massachusetts
CD	Cornell-Dubilier Electric Co.	South Plainfield, New Jersey
CONRAC	Conrac, Inc.	Glendora, California
CRL	Centralab	Milwaukee 1, Wisconsin
ELM	Elmenco Products Co.	New York, New York
ER	Erie Resistor Corp.	Erie, Pennsylvania
IR	International Rectifier Corp.	El Segundo, California
IRC	International Resistance Co.	Philadelphia 8, Pennsylvania
LF	Littelfuse Inc.	Des Plaines, Illinois
MP	Monitor Products Co.	South Pasadena, California
MU	Muter Co.	Chicago, Illinois
PH	Phalo Plastics Corp.	Shrewsbury, Massachusetts
PRL	Peerless Division of Altec Lansing Corp.	Anaheim, California
QC	Quality Components, Inc.	St. Marys, Pennsylvania
SP	Sprague Electric Co.	North Adams, Massachusetts
SYL	Sylvania Electric Products	Seneca Falls, New York

WARRANTY

CONRAC, Inc., warrants each new broadcast and industrial product manufactured by it to be free from defective material and workmanship and agrees to remedy any such defect or to furnish a new part in exchange for any part of any unit of its manufacture which under normal installation, use and service discloses such defect, provided the unit is delivered by the owner to us or to our authorized dealer or wholesaler from whom purchased, intact, for our examination, with all transportation charges prepaid to our factory, within one year from the date of sale to original purchaser and provided that such examination discloses in our judgment that it is thus defective.

This warranty does not extend to tubes after six months, or to any of our products which have been subjected to misuse, neglect, accident, incorrect wiring not our own, improper installation, or to use in violation of instructions furnished by us, nor extend to units which have been altered outside of our factory, nor to cases where the serial number thereof has been removed, defaced or changed, nor to accessories used therewith not of our own manufacture.

This warranty is in lieu of all other warranties expressed or implied and no representative or person is authorized to assume for us any other liability in connection with the sale of our radio and television products.

CONRAC, Inc.

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